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## Assessment of listing and categorisation of animal diseases within the framework of the Animal Health Law (Regulation (EU) No 2016/429): *Trypanosoma evansi* infections (including Surra)

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### Abstract

*Trypanosoma evansi* infections (including Surra) have been assessed according to the criteria of the Animal Health Law (AHL), in particular criteria of Article 7 on disease profile and impacts, Article 5 on the eligibility of *T. evansi* infections (including Surra) to be listed, Article 9 for the categorisation of *T. evansi* infections (including Surra) according to disease prevention and control rules as in Annex IV and Article 8 on the list of animal species related to *T. evansi* infections (including Surra). The assessment has been performed following a methodology composed of information collection and compilation, expert judgement on each criterion at individual and, if no consensus was reached before, also at collective level. The output is composed of the categorical answer, and for the questions where no consensus was reached, the different supporting views are reported. Details on the methodology used for this assessment are explained in a separate opinion. According to the assessment performed, it is inconclusive whether *T. evansi* infections (including Surra) can be considered eligible to be listed for Union intervention as laid down in Article 5(3) of the AHL because there was no full consensus on the criterion 5 A(v). Consequently, the assessment on compliance of *T. evansi* infections (including Surra) with the criteria as in sections 4 and 5 of Annex IV of the AHL, for the application of the disease prevention and control rules referred to in points (d) and (e) of Article 9(1) is also inconclusive, as well as which animal species can be considered to be listed for *T. evansi* infections (including Surra) according to Article 8(3) of the AHL.

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## 1. Introduction

### 1.1. Background and Terms of Reference as provided by the requestor

The background and Terms of Reference (ToR) as provided by the European Commission for the present document are reported in section 1.2 of the scientific opinion on the ad hoc methodology followed for the assessment of the disease to be listed and categorised according to the criteria of Article 5, Annex IV according to Article 9, and 8 within the Animal Health Law (AHL) framework (EFSA AHAW Panel, 2017).

### 1.2. Interpretation of the Terms of Reference

The interpretation of the ToR is as in section 1.2 of the scientific opinion on the ad hoc methodology followed for the assessment of the disease to be listed and categorised according to the criteria of Article 5, Annex IV according to Article 9, and 8 within the Animal Health Law (AHL) framework (EFSA AHAW Panel, 2017).

The present document reports the results of assessment on *Trypanosoma evansi* infections (including Surra) according to the criteria of the AHL articles as follows:

- Article 7: *Trypanosoma evansi* infections (including Surra) profile and impacts.
- Article 5: eligibility of *Trypanosoma evansi* infections (including Surra) to be listed.
- Article 9: categorisation of *Trypanosoma evansi* infections (including Surra) according to disease prevention and control rules as in Annex IV.
- Article 8: list of animal species related to *Trypanosoma evansi* infections (including Surra).

## 2. Data and methodologies

The methodology applied in this opinion is described in detail in a dedicated document about the ad hoc method developed for assessing any animal disease for the listing and categorisation of diseases within the AHL framework (EFSA AHAW Panel, 2017).

## 3. Assessment

### 3.1. Assessment according to Article 7 criteria

This section presents the assessment of *T. evansi* infections (including Surra) according to the Article 7 criteria of the AHL and related parameters (see Table 2 of the opinion on methodology (EFSA AHAW Panel, 2017)), based on the information contained in the fact-sheet as drafted by the selected disease scientist (see section 2.1 of the scientific opinion on the ad hoc methodology) and amended by the AHAW Panel.

#### 3.1.1. Article 7(a) Disease Profile

*Trypanosoma (Trypanozoon) evansi* (Steel 1885) Balbiani, 1888, was the first pathogenic mammalian trypanosome to be described in the world, in 1880, by Griffith Evans, in the blood of Indian equines and dromedaries (Hoare, 1972). *T. evansi* is a parasite derived from the *Trypanosoma brucei* lineage; compared to *T. brucei* subsp., it is genetically characterised by a loss of kinetoplastic maxicircles (which makes it unable to develop in tsetse flies) and a high homogeneity in the kinetoplastic minicircles (Lun and Desser, 1995). Surra is the disease caused by *T. evansi* infections which may occur in a large range of mammals (Hoare, 1972), and very occasionally in humans (Truc et al., 2014). *T. evansi* is mainly mechanically transmitted by biting insects such as tabanids and stomoxys. Therefore, the disease is able to spread outside the tsetse distribution area in Africa, towards the Middle East and Asia but also to Latin America.

Surra is an acute, chronic or subclinical disease being very often fatal in camels, horses and dogs, but can also seriously affect cattle and buffaloes. It is generally a mild disease in goats, sheep and pigs. Surra is also known as Mal de caderas, Peste-Boba or Derrengadera in Latin America and El debab, Mbori, Guifar and Menchaca in Africa (Desquesnes et al., 2013b). Surra can cause fever, anaemia, weakness and nervous symptoms; it is responsible for major production losses (meat, milk, draught power, manure and fertility), leading to cachexia and sometimes abortion and/or death in the absence of treatment (Desquesnes et al., 2013b).

### 3.1.1.1. Article 7(a)(i) Animal species concerned by the disease

#### *Susceptible animal species*

##### Parameter 1 – Naturally susceptible wildlife species (or family/orders)

Almost all wild mammals are known to be susceptible to *T. evansi* infection:

- Perissodactyla: Tapiridae (Hoare, 1972) and Rhinocerotidae (Mohamad et al., 2004);
- Artiodactyla, notably antelopes, Cervidae (sambar deer (*Rusa unicolor*), Rusa deer (*Rusa timorensis*) (Indrakamhang, 1998), hog deer (*Axis porcinus*) (Tuntasuvan et al., 2000), barking deer (*Muntiacus muntjak*) and spotted deer (*Axis axis*) (Losos, 1980), Suidae (wild pigs) and Tayassuidae (Herrera et al., 2008);
- Carnivora: coati (*Nasua nasua*) (Silva et al., 1996), wild dogs, foxes (Hoare, 1972), tiger (*Panthera tigris*) (Bhaskararao et al., 1995), ocelot (*Leopardus pardalis*) (Herrera et al., 2011), Asiatic black bear (*Ursus thibetanus*) (Muhammad et al., 2007), leopards (*Panthera pardus*) and jaguars (*Panthera onca*) (Sinha et al., 1971);
- Proboscidea: Asian elephant (*Elephas maximus*) (Evans, 1910);
- Rodentia: capybara (*Hydrochoerus hydrochaeris*) (Reveron et al., 1992), common hamster (*Cricetus cricetus*) (Stephen, 1986) and rats (Arias et al., 1997; Milocco et al., 2013);
- Lagomorpha: pika (*Ochotona* spp.) (Hoare, 1972);
- Chiroptera: vampire bats (Hoare, 1965);
- Primates: orangutan (*Pongo pygmaeus*; *Pongo abelii*), howler-monkey (*Alouatta* sp.) (Van den Bergh, 1939; Ruiz-Martinez, 1971).

##### Parameter 2 – Naturally susceptible domestic species (or family/orders)

Almost all domestic mammals are known to be susceptible to infection with *T. evansi*:

- Perissodactyla, notably Equidae (horse, donkey and their crossbreeds) (Hoare, 1972);
- Artiodactyla, notably Camelidae (Bactrian and dromedary camels but also llamas (Ferris, 1984; Gardiner and Mahmoud, 1992), Bovidae (cattle, sheep, goats, Asian buffalo) and Suidae (pig) (Hoare, 1972; Gill, 1977);
- Carnivora (dog, cat) (Tarello, 2005);
- Proboscidea: Asian elephant (Evans, 1910).

##### Parameter 3 – Experimentally susceptible wildlife species (or family/orders)

The following species were experimentally infected: wallabies (Reid et al., 2001), mongooses (Misra et al., 2016), *Proechimys* sp. (Morales and Carreno, 1976) and *Macaca mulatta* (Vittoz, 1955; Misra et al., 2016). Experimental infection of young pigeons was obtained (Mandal et al., 2008).

##### Parameter 4 – Experimentally susceptible domestic species (or family/orders)

Rabbits (Uche and Jones, 1992), guinea pigs, rats, mice, guanacos (*Lama guanicoe*) (Kinne et al., 2001), goats (Morales et al., 2006), cats and dogs (Moloo et al., 1973; Misra et al., 2016).

##### Parameter 5 – Wild reservoir species (or family/orders)

Deer, wild pigs, capybaras (Morales et al., 1976; Rodrigues et al., 2009) and vampire bats (Hoare, 1965, 1972).

##### Parameter 6 – Domestic reservoir species (or family/orders)

Natural domestic reservoirs of *T. evansi* are varied according to the geographical areas; in Africa, they appear to be camels themselves (Hoare, 1972), in Latin America and Asia, cattle and buffaloes are the main reservoir (Hoare, 1965; Desquesnes, 2004; Desquesnes et al., 2013a,b). Other occasional reservoirs are domestic deer and donkeys. Overall, camels, cattle and buffaloes remain the main domestic reservoir of *T. evansi*, but goats and sheep may also play a role (Boehringer and Prosen, 1961; Birhanu et al., 2015).



### 3.1.1.2. Article 7(a)(ii) The morbidity and mortality rates of the disease in animal populations

#### Morbidity

##### Parameter 1 – Prevalence/incidence

The prevalence and incidence depend on the host species and the vector activity. In horses, at population level, the prevalence is generally very low (Berlin et al., 2012), but at the farm level, the incidence can be very high within a short period of time during biting-insects season (Laha and Sasmal, 2009); however, in some highly enzootic areas in India and Latin America, prevalence can be high (Silva et al., 1995b; Jaiswal et al., 2015; Da Silva et al., 2016). In camels, prevalence might reach 20–70% (OIE, online). In buffaloes and cattle, the prevalence and incidence are generally low (around 10%) (Desquesnes et al., 2009b; Kocher et al., 2015a) but can be high in some outbreaks with strong clinical signs (Chartier et al., 2000). Domestic dogs present low prevalence due to sporadic infections most often linked with ingestion of infected meat (Singh et al., 1993; Hosseini et al., 2007; Ravindran et al., 2008).

##### Parameter 2 – Case-morbidity rate (% clinically diseased animals out of infected ones)

The case-morbidity rate is always very high in horses and dogs (> 90%) (Singh et al., 1993; Silva et al., 1995b).

It is high in camels, > 40% (Tehseen et al., 2015).

It is medium to low in other hosts, such as cattle, sheep and goats (Losos, 1980; FAO, 1998; Jaiswal et al., 2015).

#### Mortality

##### Parameter 3 – Case-fatality rate

The case-fatality rate is always very high in horses and dogs (> 90%) (Eloy and Lucheis, 2009).

It is high to medium in camels and elephants, sometimes high in buffaloes and cattle (in naïve populations) (Reid, 2002).

It is medium to low in deer, buffaloes and cattle in enzootic areas (Reid, 2002; Desquesnes et al., 2013b).

The case-fatality rate is generally low in pigs, sheep and goats (Boehringer and Prosen, 1961; Losos, 1980). Figures of clinically sick animals can be seen in Desquesnes et al. (2013a).

### 3.1.1.3. Article 7(a)(iii) The zoonotic character of the disease

#### Presence

##### Parameter 1 – Report of zoonotic human cases worldwide

Apart from the cases observed in Africa, for which the *Trypanosoma* species was not confirmed, six human cases have been reported so far in Asia, among them two recent cases fully documented (including molecular identification, treatment and clinical and laboratory follow-up of the patient until full recovery); one in India linked with a deficit in apolipoprotein-L1 (ApoL1), another one in Vietnam; in both cases, transcutaneous infection was suspected (Joshi et al., 2005; Powar et al., 2006; Shegokar et al., 2006; Vanhollebeke et al., 2006; Van Vinh Chau et al., 2016). The case in Vietnam could have been due to transient deficiency in ApoL1 in the blood as a result of liver dysfunction.

### 3.1.1.4. Article 7(a)(iv) The resistance to treatments, including antimicrobial resistance

##### Parameter 1 – Resistant strain to any treatment even at laboratory level

Trypanosomes have developed chemoresistance in most parts of the world (Peregrine and Mamman, 1993). Individual resistance of some strains of *T. evansi* to trypanocides has been recorded, notably in China and Sudan, but there is no report of natural cross-resistance to all trypanocides available (Zhang et al., 1991; El Rayah et al., 1999). Despite this, it appears that there is no drug available which can cure the disease once the nervous system of the host is invaded (Tuntasuvan et al., 1997, 1998, 2000).

### 3.1.1.5. Article 7(a)(v) The persistence of the disease in an animal population or the environment

#### *Animal population*

##### Parameter 1 – Duration of infectious period in animals

In horses, evolution is generally fast, but chronic cases can occur for 3 months to 3 years or more (Gill, 1977), whereas in camels evolution is generally fast, although chronic cases can occur for more than 3 years (Rottcher et al., 1987). Also, in dogs, the evolution is fast and fatal, usually within 2 months (Gill, 1977; Herrera et al., 2004; Rjeibi et al., 2015).

In bovines, persistence of the disease is generally of medium term (3 months), but persistence of the infection may last several months or years (OIE, 2012), while in capybaras, vampire bats and some other wild host species, the duration of the infectious period is not limited in time (Hoare, 1965).

In wild rodents, it is not known whether the parasite can persist for long periods, but survival of infected animals may last one month or more (Kocher et al., 2015b).

##### Parameter 2 – Presence and duration of latent infection period

The period between infection and the appearance of clinical signs has been estimated as 5–30 days in horses and dogs, 5–60 days in camels, but it can be as high as 4 months and possibly infinite in bovines and some other hosts of mild susceptibility (Hoare, 1972). The period from infection to possible detection using laboratory tests has been arbitrarily defined as 6 months in cattle, camel and horse by the ad hoc group of the OIE on Surra.

##### Parameter 3 – Presence and duration of the pathogen in healthy carriers

*T. evansi* can remain in the host for several months or even years and relapse in bovines and camels (Mohler and Thompson, 1909; Hoare, 1972; Rottcher et al., 1987; OIE, 2012).

#### *Environment*

##### Parameter 4 – Length of survival (dpi) of the agent and/or detection of DNA in selected matrices (soil, water, air) from the environment (scenarios: high and low T)

There is no survival in the environment; survival in meat is considered to be below 2 days, based on expert's opinion, and length of survival in the blood at 4°C, declines dramatically after 48 h, even if living parasites can still be found 7 days after blood collection (Monzón et al., 1995a).

### 3.1.1.6. Article 7(a)(vi) The routes and speed of transmission of the disease between animals, and, when relevant, between animals and humans

#### *Routes of transmission*

##### Parameter 1 – Types of routes of transmission from animal to animal (horizontal, vertical)

In herbivores, the main route of transmission is through haematophagous flies acting as mechanical vectors (horizontal transmission); transmission can thus be fast, but is seasonal, and requires close proximity between animals. The main vectors are biting haematophagous flies (Diptera) included in the family Tabanidae (Horseflies, deer flies and clegs are the main vectors); other species included in different families, such as *Stomoxys* spp., *Haematobia* spp. and some non-biting haematophagous flies are also suspected, such as *Musca crassirostris* (Gill, 1977; Desquesnes et al., 2013b).

Vertical transmission can occur especially in bovines, sheep and donkeys and possibly in camels, but is of low prevalence; it may not occur in horses and dogs due to the severity of the clinical signs leading to abortion and death (Pathak and Kapoor, 1999; Campigotto et al., 2015; Kumar et al., 2015).

Horizontal transmission via colostrum and milk has been described in experimental infections of sheep (Campigotto et al., 2015). Transmission of *T. evansi* to carnivores generally occurs via the peroral route, from infected herbivore meat (dogs/slaughter houses) or wildlife (for wild carnivores or hunting dogs) (Desquesnes, 2004). Vampire bats can get the infection perorally (through the stomach mucosae) when biting and sucking blood on infected herbivores, or other bats of the colony, or by transcutaneous route when being bitten by infected congeners (in Latin America only) (Hoare, 1965).



### Parameter 2 – Types of routes of transmission between animals and humans (direct, indirect, including food-borne)

The rare cases of infections of humans by *T. evansi* have been reported to be either accidental inoculation (iatrogenic) or contamination by infected meat or blood through a skin wound (Joshi et al., 2005, 2006; Powar et al., 2006; Shegokar et al., 2006; Van Vinh Chau et al., 2016); however, some other routes might be efficient such as peroral infection (Vergne et al., 2011) and mechanical transmission by arthropods (tabanids and stomoxys) (Desquesnes et al., 2013a).

#### *Speed of transmission*

### Parameter 3 – Incidence between animals and, when relevant, between animals and humans

The incidence might be very high (up to 100%) in highly susceptible herbivores (horses and camels) when they exhibit high parasitaemia in the presence of high densities of mechanical vectors.

The incidence is moderate in bovines because of moderate susceptibility to infection and moderate risk of disease development (Dia and Desquesnes, 2007).

The incidence is sporadic in carnivores while the peroral route of infection requires feeding on infected carcasses (Jaiswal et al., 2015).

### Parameter 4 – Transmission rate (beta) (from $R_0$ and infectious period) between animals and, when relevant, between animals and humans

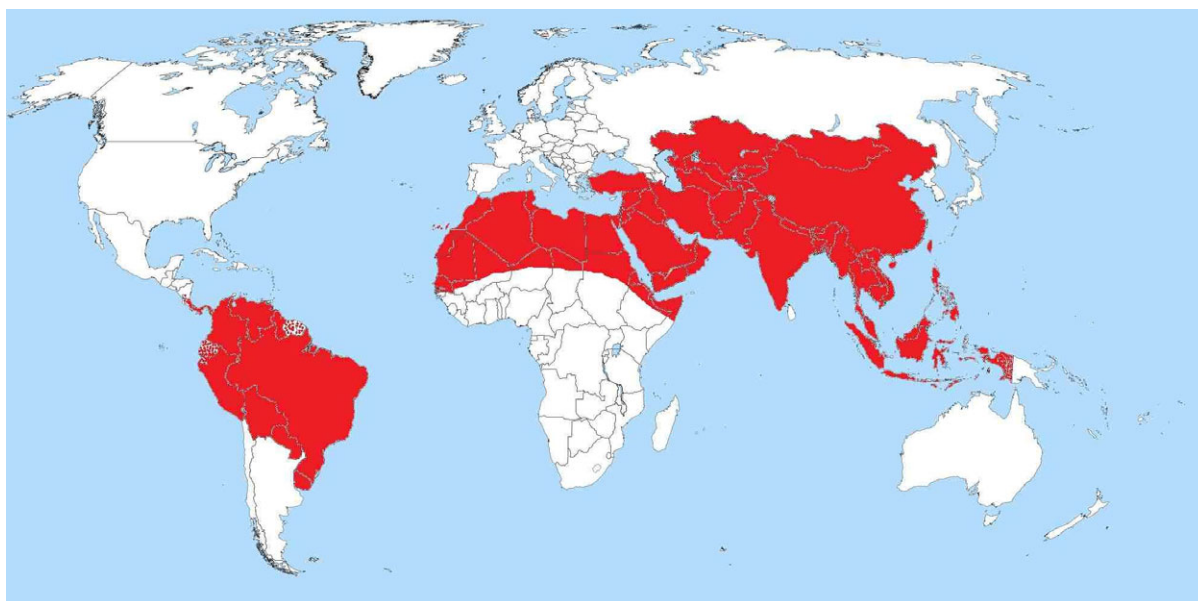
No data are available on the transmission rate of Surra. However, one model has been developed so far on Surra in buffaloes in the Philippines, where infection rates (success) for Surra were set differently for innate susceptible (S to I) and innate resistant (R to I) hosts, that is, 0.2 for innate resistant animals and 0.8 for innate susceptible hosts. The values used were estimated from field data (Dobson et al., 2009).

### **3.1.1.7. Article 7(a)(vii) The absence or presence and distribution of the disease in the Union, and, where the disease is not present in the Union, the risk of its introduction into the Union**

#### *Presence and distribution*

### Parameter 1 – Map where the disease is present in EU

The disease is absent from the continental European Union at the present time as shown in Figure 1; however, *T. evansi* is present (endemically in the wild fauna) in French Guiana (Desquesnes, 2004) and in the Canary Islands (endemic/epidemic in camels) (Molina et al., 1999; Gutierrez et al., 2000).



**Figure 1:** Distribution of the *Trypanosoma* disease in the world (Desquesnes et al., 2013a)

## Parameter 2 – Type of epidemiological occurrence (sporadic, epidemic, endemic) at MS level

Sporadic outbreaks occur, most recently from camels imported from the Canary Islands, in Aveyron, France, in 2005 (Desquesnes et al., 2007, 2008) and in Alicante, Spain, in 2008 (Tamarit et al., 2010). Recent outbreaks in camels or camels and horses were observed respectively in France and Spain (Gutierrez et al., 2010).

In French Guiana, *T. evansi* is rarely but regularly observed only in hunting dogs because Surra is thought to be endemic in wildlife only (Desquesnes, 2004).

Surra has been demonstrated in camels in the Canary Islands (Gutierrez et al., 2000) with an epidemic nature (Gutierrez et al., 2005).

### *Risk of introduction*

As surra is present in the French Guyana and in the Canary Islands, the following points are addressed only considering the risk of introduction into the continental EU.

## Parameter 3 – Routes of possible introduction

Both controlled and uncontrolled movements of wild and domestic large herbivores should be considered as possible route of introduction of surra from Turkey into the continental EU (Azrug and Burgu, 2011). Large herbivores as healthy carriers or incubating animals are the main potential source of introduction; they could be mostly camels, horses or bovines, and possibly sheep, goats and pigs; so far, the two cases observed in Spain and France were due to importation of camels (Gutierrez et al., 2010). Also controlled and uncontrolled movements of dogs, hamster, pikas and lagomorphs could act as possible route of introduction.

## Parameter 4 – Number of animal moving and/or shipment size

Data on uncontrolled wild and domestic animals entering EU from Turkey are not known. The number of camels introduced into EU has been so far very limited (< 20 per MS/year).

## Parameter 5 – Duration of infectious period in animal and/or commodity

See Section 3.1.1.5.

## Parameter 6 – List of control measures at border (testing, quarantine, etc.)

Import of bovines, sheep, goats and pigs are only allowed into the European Union (EU) if the animals originate from authorised third countries: Andorra, Chile, Canada, Greenland, Island, Mayotte, New Zealand and Saint Pierre et Miquelon. These countries are not enzootic countries for surra; the certificate does not include any testing for surra, which might not be fully safe as concerns Chile, due to close vicinity with infected areas (Peru, Bolivia and Argentina).

For camelids originating from non-authorised countries, a quarantine should be made in Saint Pierre et Miquelon, documents for 'Rum' and 'Cam' should be exhibited as well as a negative blood smear examination at 2 and 42 days after their arrival (Annex I to Regulation (EC) No 206/2010<sup>1</sup>); since this diagnostic method is of very low sensitivity, the risk of undetected carrier is significant.

For live Equidae and their products, temporary or permanent importations are strictly regulated for each type and third country according to a Commission Decision of 6 January 2004 (2004/211/EC).<sup>2</sup>

However, in this list at least six countries are authorised to export all types of equines to the EU, although they are known to be enzootic for Surra; namely: Argentina (Monzon and Colman, 1988; Monzon et al., 1995b, 2003; Bono Battistoni et al., 2016), Algeria (Bennoune et al., 2013), Morocco (Atarhouch et al., 2003), Tunisia (Hoare, 1972; Rjeibi et al., 2015), Israel (Berlin et al., 2012) and Paraguay (Hoare, 1972).

Due to latent infections, carrier status and possible presence of viable parasites in the semen or other biological products, animals, or products of animal origin, should be born in or originated from authorized country, bred in surra-free farms, be submitted to quarantine and pass successfully at least 3 laboratory tests including blood examination, serological (ELISA & CATT) and molecular detection

<sup>1</sup> Regulation (EC) No 206/2010 of the European Parliament and of the Council of 12 March 2010 laying down lists of third countries, territories or parts thereof authorised for the introduction into the European Union of certain animals and fresh meat and the veterinary certification requirements (1). OJ L 73, 20.3.2010, p. 1–121.

<sup>2</sup> Commission Decision of 6 January 2004 establishing the list of third countries and parts of territory thereof from which Member States authorise imports of live equidae and semen, ova and embryos of the equine species, and amending Decisions 93/195/EEC and 94/63/EC (2004/211/EC). OJ L 73, 11.3.2004, p. 1.

(PCR) as described in surra chapter of the OIE terrestrial manual (Chapter 2.1.17) (OIE, 2012). Such measures should be elaborated carefully to avoid the risk of introduction.

#### Parameter 7 – Presence and duration of latent infection and/or carrier status

Latent infection and/or carrier status can occur and last for several months to years in camels and bovines and possibly in small ruminants. Serological detection might not always be able to detect such animals when they are in the incubation period (Desquesnes et al., 2008, 2009a).

#### Parameter 8 – Risk of introduction

Large herbivores as healthy carriers or incubating animals can introduce viable parasite into EU. Lesson learn from the previous camel introductions onto the French and Spain mainlands, trading of camels from infected area should be made with extreme precautions. Providing reliable laboratory examinations be carried out (e.g. by one of the 3 OIE reference laboratories) and the limited amount of imported animals, such risk, could still be considered as very unlikely.

For horses that fall in the category of 'high health, high performance' (HHP) as defined by the OIE, regulations are less strict since the health status of this equine subpopulation is safeguarded by the application of specific measures pertaining to veterinary supervision and certification, identification, traceability and compliance to biosecurity measures. This is aimed to create and maintain a functional separation between these horses and other equids, at all times, including the usual place of residence and venues of international competitions, and during transport by road or air. As far as this compliance is assured and validated through continuous veterinary supervision, for these animals, risk can be considered as very unlikely.

Import testing of animals for Surra should be carried out in countries such as Greece and Bulgaria, since they might be opportunity to introduce the parasite into Europe from the bordering Turkey (Azrug and Burgu, 2011). Concerning uncontrolled movement of animals, considering that it is very difficult to provide a reliable estimation and that transboundary movements of wild animals cannot be easily controlled, such risk of introduction cannot be estimated.

Dogs might be carriers for a short time before they exhibit clinical signs, however they are not an efficient source of infection to spread the disease; they are rather epidemiological dead-end hosts (Desquesnes et al., 2013a). Hamsters and pikas have been found naturally infected (Kazakhstan) and could be a way of introduction if transported and not checked at borders, however, they would hardly act as a source to infect large mammals (Hoare, 1972). Lagomorphs have been proved to be experimentally susceptible hosts to *T. evansi* infections and their movement could act as route of possible introduction, however, they have not been found naturally infected (Uche and Jones, 1992; Da Silva et al., 2011; Misra et al., 2016), thus the risk of introduction can be considered negligible.

### **3.1.1.8. Article 7(a)(viii) The existence of diagnostic and disease control tools**

#### *Diagnostic tools*

#### Parameter 1 – Existence of diagnostic tools

Several diagnostic tools are available; those recommended by the OIE (terrestrial manual, chapter 2.1.17) are the following (OIE, 2012):

- Giemsa stained blood smear microscopic examination;
- Fresh blood examination with a microscope can be proceeded, either with plain blood or better after centrifugation in a capillary tube (haematocrit centrifuge technique (HCT)) (Woo, 1970);
- PCR methods can be applied to plain blood or more sensitive with buffy coat, using primers of various taxon levels from subgenus *Trypanozoon* (Masiga et al., 1992), species (Panyim et al., 1993), to type A Rotat 1.2 (Claes et al., 2004) or type B *T. evansi* (Njiru et al., 2006);
- Card agglutination test (CATT) for *T. evansi* is commercially available from ITM Anvers, Belgium for antibodies detection direct agglutination test;
- ELISA *T. evansi* for immunoglobulin G (IgG) detection is described in the OIE terrestrial book, only referenced laboratories can prepare the antigens made of the soluble proteins from a whole cell lysate of *T. evansi*.

A trypanolysis test (TT) is also available at the OIE reference laboratory of ITM, Anvers, Belgium. This test is more specific and is mainly applied as serological confirmation of CATT or ELISA seropositive animals. The major disadvantages of this test are the use of living animals, the high cost (around 250 €) and the fact that it will not detect infections with *T. evansi* type B, the rare type of

*T. evansi* found in camels in Kenya, Ethiopia and Sudan (Fikru et al., 2015). For parasite detection in blood, the mini Anion Exchange Centrifugation Test (mAECT) can be used. The detection limit is 100 parasites/mL. The version that is used for human African trypanosomiasis is applicable to horse and camel. For goat, a slight adaptation of the buffer is necessary (Gutierrez et al., 2004).

#### *Control tools*

#### Parameter 2 – Existence of control tools

Control tools are: (i) the use of trypanocidal drugs (which can never guarantee to get rid of the parasites due to possible extravascular localisation of the parasites (Schillinger and Röttcher, 1986), (ii) isolation of infected animals under biting-fly proof conditions, (iii) slaughtering of the infected animals, (iv) destruction of carcasses is necessary as well as any issues from the infected animals since the parasite can survive in fresh blood, meat and other organs possibly up to 2 days, and be a source of infection for carnivores; (v) additional control of biting insects is necessary in the case of herbivores (Desquesnes et al., 2013a).

### **3.1.2. Article 7(b) The impact of diseases**

#### **3.1.2.1. Article 7(b)(i) The impact of the disease on agricultural and aquaculture production and other parts of the economy**

##### *The level of presence of the disease in the Union*

#### Parameter 1 – Number of MSs where the disease is present

The disease is currently not present at EU continental level; however, the Canary Islands experienced Surra epidemics in camels (Tamarit et al., 2010).

##### *The loss of production due to the disease*

#### Parameter 2 – Proportion of production losses (%) by epidemic/endemic situation

In enzootic countries, important losses concern milk, meat, manure production, work capacity, semen quality and reproduction performances (Enwezor and Sackey, 2005; Salah et al., 2015), including treatment costs, intercurrent diseases, death and abortion (Silva et al., 1995a; Seidl et al., 1997). About 13% of the horses would be lost in the absence of control of Surra in the Pantanal, Brazil (Seidl et al., 2001). In Philippines, the birth rate of buffaloes has been reported as 47% in non-infected females compared to 15% in infected ones (Dargantes et al., 2009). In India, Surra is thought to be responsible of very heavy loss, but there are no percentages of production loss available (Pathak and Singh, 2005).

#### **3.1.2.2. Article 7(b)(ii) The impact of the disease on human health**

##### *Transmissibility between animals and humans*

#### Parameter 1 – Types of routes of transmission between animals and humans

The rare cases of infections of humans by *T. evansi* have been reported to be either accidental inoculation (iatrogenic) or contamination by infected meat or blood through a skin wound (Joshi et al., 2005, 2006; Powar et al., 2006; Shegokar et al., 2006; Van Vinh Chau et al., 2016).

#### Parameter 2 – Incidence of zoonotic cases

The incidence of zoonotic cases is very low since fewer than 10 cases have been described so far (Truc et al., 2013); most of the humans are not susceptible to the infection due to the presence of trypanolytic factors (among which ApoL1 would be determinant) in normal human serum (Vanhollebeke et al., 2006). However, in a recent case reported in Vietnam, the ApoL1 level and DNA sequence appeared to be normal, thus, the development of *T. evansi* in this non-immunosuppressed patient is not fully understood (Van Vinh Chau et al., 2016) and might have been due to transient insufficiency in ApoL1.

##### *Transmissibility between humans*

#### Parameter 3 – Human to human transmission is sufficient to sustain sporadic cases or community-level outbreak

There is no information available, while the number of human cases is low.

Parameter 4 – Sporadic, endemic, epidemic, or pandemic potential

The level of human cases is low, so primarily sporadic potential.

*The severity of human forms of the disease*

Parameter 5 – Disability-adjusted life year (DALY)

In the two recent fully documented cases (India and Vietnam), survival of the patient was a serious concern due to high parasitaemia, and the disease appeared to be very similar to the rhodesiense form of sleeping sickness in its blood phase (phase 1), thus, to avoid any risk of passage to phase 2 (neurologic invasion) the patients were treated using suramin. Due to the disease and convalescence, these two patients were unable to work for several months.

*The availability of effective prevention or medical treatment in humans*

Parameter 6 – Availability of medical treatment and their effectiveness (therapeutic effect and any resistance)

In the two recent fully documented cases (India and Vietnam), fully curative treatments were obtained using suramin (1 g intravenous, 5 times at 1 week interval) (Joshi et al., 2006; Van Vinh Chau et al., 2016).

Parameter 7 – Availability of vaccines and their effectiveness (reduced morbidity)

None are available due to the ability of Trypanosomes to exhibit a series of variable surface glycoproteins. All attempts to develop vaccines were so far unsuccessful.

**3.1.2.3. Article 7(b)(iii) The impact of the disease on animal welfare**Parameter 1 – Severity of clinical signs at case level and related level and duration of impairment

The clinical expression of Surra generally includes fever, anaemia, loss of appetite and weight, loss of condition and productivity, oedema, nervous signs and/or abortion, cachexia, and death, with or without more peculiar signs related to the host species. However, the severity is variable from one species to another.

The most severe clinical cases of Surra are observed in horses, dogs and camels and to a lesser extent in donkeys and mules; treatment may be efficient when applied early, otherwise the evolution is most often fatal after recurrent fever, anaemia and loss of condition.

In horses, the course is most often acute, in later stages, invasion of the nervous system leads to neurological signs. In endemic areas, such as India and Latin America, chronic forms are observed however, the issue remains fatal most of the time (Gill, 1977; Jaiswal et al., 2015).

In camels, the course can be acute, subacute or chronic; in acute cases, clinical signs are intermittent, in chronic form, the course of the disease is 1–3 years with clinical signs including anaemia, emaciation, skin abscess and pica in young camels (Rottcher et al., 1987; Singh and Singla, 2013).

Dogs present very severe clinical signs, including, anaemia, bilateral keratitis and fatal evolution, while the treatment is of low efficacy (Rjeibi et al., 2015).

In buffaloes and cattle, the severity is mild in Africa and Latin America but high in recently infected herds in Asia, with frequent abortion and a mortality reaching 20–90% (Gill, 1977). In cattle, fever, abortion, and decreased milk production are frequently reported and high mortality can be recorded. In all cases, if the clinical signs recede, it is suspected that Surra exacerbates other latent infections and jointly very long impairments (Desquesnes et al., 2013b; Jaiswal et al., 2015). In sheep and goats, the clinical signs are generally mild (Pathak and Singh, 2005; Jaiswal et al., 2015) but in acute evolution sheep may die within 2 weeks accompanied by spleen and lymph nodes enlargement (Audu et al., 1999). Pigs are generally symptomless or exhibit very mild signs with fever, anorexia, emaciation and abortion (Arunasalam et al., 1995).

In domestic elephants, Surra has severe clinical signs, the animals are unable to work and the disease may have potential fatal evolution; some animals may recover with or without treatment, and may also become chronic (Evans, 1910).



### 3.1.2.4. Article 7(b)(iv) The impact of the disease on biodiversity and the environment

#### Biodiversity

##### Parameter 1 – Endangered wild species affected: listed species as in CITES and/or IUCN list

- Asian elephants: *Elephas maximus* (endangered (IUCN, online); appendix 1, CITES)
- Asian rhinoceros: *Dicerorhinus sumatrensis* (critically endangered (IUCN, online); appendix 1, CITES)
- Asiatic black bear: *Ursus thibetanus* (vulnerable (IUCN, online); appendix 1, CITES)
- Tayassuidae species (appendix 1 and 2, CITES)
- *Vulpes bengalensis* and *Vulpes vulpes* (appendix 3, CITES)
- *Panthera tigris*, *Panthera pardus*, *Panthera onca*, *Leopardus pardalis* (appendix 1, CITES)
- *Pongo pygmaeus* (appendix 1, CITES)
- <https://www.cites.org/eng/app/appendices.php>

##### Parameter 2 – Mortality in wild species

Surra can be fatal in rhinoceros, elephants, deer, wild pigs and carnivores, however, the morbidity and mortality are unknown in these species. In Latin America, capybara seems to be affected, but a part of the population is subclinical or healthy carrier (Morales et al., 1976).

#### Environment

##### Parameter 3 – Capacity of the pathogen to persist in the environment and cause mortality in wildlife

*T. evansi* is not persisting in the environment. Wild carnivores may get the infection by eating a prey of freshly killed infected animal (Jaiswal et al., 2015).

### 3.1.3. Article 7(c) Its potential to generate a crisis situation and its potential use in bioterrorism

##### Parameter 1 – Listed in OIE/CFSPH classification of pathogens

Surra is not on the list of the CFSPH for animal disease from potential bioterrorism agent and it is on the OIE-Listed diseases, infections and infestations in force in 2017 (OIE, online)

##### Parameter 2 – Listed in the Encyclopaedia of Bioterrorism Defence of Australia Group

It is not listed.

##### Parameter 3 – Included in any other list of potential bioagroterrorism agents

It is not listed in the CDC Bioterrorism Agents/Diseases.

<https://emergency.cdc.gov/agent/agentlist.asp>

### 3.1.4. Article 7(d) The feasibility, availability and effectiveness of the following disease prevention and control measures

#### 3.1.4.1. Article 7(d)(i) Diagnostic tools and capacities

##### Availability

##### Parameter 1 – Officially/internationally recognised diagnostic tool, OIE certified

The diagnostic methods recommended by the OIE (OIE, 2012) are listed in Section 3.1.1.8.

Two types of *T. evansi* are described. Type A is the most common. It is found in all countries where *T. evansi* is endemic, and type B is rare and has been isolated from dromedary camels in Kenya and Ethiopia (Ngaira et al., 2004, 2005; Njiru et al., 2006; Birhanu et al., 2015, 2016). Moreover, molecular evidence exists that *T. evansi* type B also occurs in Sudan where almost half of the tested strains (13/30) were of type B (Salim et al., 2011).

As concerns molecular diagnosis, the existence of non-RoTat parasites leaves room for false negative results when using RoTat 1.2 specific primers in PCR diagnosis.

As concerns serological diagnosis, beside the presence of the RoTat 1.2 gene, which seems to be predominant, it appears that the RoTat 1.2 VSG is not always expressed since a significant part of samples positive with RoTat1.2 PCR are negative by CATT, whose sensitivity may be as low as 72–80%



in camels (Pathak et al., 1997; Fikru et al., 2015), 12% in cattle (Desquesnes et al., 2011) and somehow inconsistent in pigs (Holland et al., 2005).

### Effectiveness

#### Parameter 2 – Se and Sp of diagnostic test

Trypanosome infection evolves by waves of parasitaemia (ups and downs, in links with the production of specific antibodies recognising a current variant surface glycoprotein (VSG)), which generates inconsistent sensitivity of the parasitological and molecular techniques; for this reason, iterating sampling of suspected animals improves the detection. Conversely, antibody levels are more stable and antibody detection is more reliable, especially IgG detection (IgG levels are known to be stable in the serum of infected animals), thus they provide better negative predictive value (NPV) than parasitological and molecular techniques.

- Giemsa stained blood smear (GSBS): cheap and fast, the sensitivity of the test is very low; it can be positive when the parasitaemia is  $> 105$  parasites/mL; specificity of the test allows subgenus identification (*Trypanozoon*); cattle and small ruminants can be infected with non-pathogenic trypanosomes, respectively, *Trypanosoma theileri* and *Trypanosoma melophagium* that are easily distinguished from trypanozoos on morphological basis (length 60–120  $\mu\text{m}$ , larger kinetoplast (1–1.2  $\mu\text{m}$ )); GSBS has a very high positive predictive value (PPV) but NPV is very low due to its very low sensitivity.
- HCT: cheap and fast, sensitivity of the test is low; it can be positive when the parasitaemia is  $> 102\text{--}3$  parasites/mL.
- Mouse inoculation technique (MIT): it is time consuming and presents ethical concerns (using live animals), however, sensitivity of the test is high; it can be positive when the parasitaemia is  $> 10$  parasites/mL; specificity allows subgenus identification through GSBS and molecular characterisation after multiplication in mice; MIT allows parasite isolation for further characterisation; PPV is very high but NPV is low.
- PCR: medium cost and delayed, but sensitivity is high; it can be positive when the parasitaemia is  $> 1\text{--}100$  parasites/mL (depending on the PCR and DNA preparation methods used); it allows parasite characterisation at various levels: subgenus, species and type; PPV is very high (only contamination in PCR would lead to false positive result) but NPV remains low in case of low parasitaemia.
- The specificity of the PCR test with TBR primers is jeopardised by its extremely high sensitivity, thus making it prone to contamination which may affect its PPV.
- mAECT: medium cost. Not widely available and only applicable on camel, horse and goat. Very high specificity and high sensitivity ( $< 100$  trypanosomes/mL).
- CATT: cheap and fast, sensitivity is generally high in Equidae, buffalo, camels, sheep, goats and dogs, with a medium to high specificity; specificity and sensitivity are low in cattle high PPV and medium NPV in horses, dogs and camels; lower values in other host species.
- Antibody ELISA: cheap but delayed; the sensitivity and specificity are high (90–95% on average) in horses, camels, bovines and buffaloes; positive seroconversion is around 2 weeks while negative seroconversion is around 3–4 months; PPV is high providing treatment are documented; NPV very high unless very recent infection.
- Trypanolysis test (TL): very expensive and delayed, TL is used for confirmation of CATT or ELISA positive cases. The sensitivity is considered as high. The specificity is very high and even strain dependent; indeed, only strains expressing RoTat 1.2 gene can be positive; most of the *T. evansi* strains from the whole distribution area of *T. evansi* are type A, thus considered to express RoTat 1.2 as an early antigen; however, some rare strains defined as type B, such as described in Kenya, Ethiopia and Sudan, cannot be detected using TL.

Antibody detection tests remain positive several months after curative treatment and therefore for assessment of treatment success they are only appropriate under medium term follow-ups (3–6 months).

### Feasibility

#### Parameter 3 – Type of sample matrix to be tested (blood, tissue, etc.)

- Blood from large veins
- Blood from capillary vessels (sensitivity might be better for parasitological examinations)
- Oedema liquid

- Lymph node liquid
- Cerebrospinal fluid (CSF)
- Genital fluid (vaginal or preputial flush)
- Impression smears of lungs, liver, and kidney can be made at post-mortem (OIE, online).

### 3.1.4.2. Article 7(d)(ii) Vaccination

No vaccines are available.

### 3.1.4.3. Article 7(d)(iii) Medical treatments

#### Availability

#### Parameter 1 – Types of drugs available on the market

- Diminazene aceturate (DA) is an aromatic diamidine used to control Babesia and trypanosome infection in ruminants (bovines, sheep, goats); it can be used in equines and dogs but exhibiting poor efficacy and tolerance in these species. The dose recommended for the treatment of infections due to parasites belonging to the *Trypanozoon* subgenus is 7 mg/kg body weight (bw) of DA, via intramuscular injection.
- Isometamidium chloride (ISMC) belongs to the phenanthridine family but it is not known as a carcinogenic agent; it can be used for curative (0.5 mg/kg bw) and preventive (1 mg/kg bw) treatment of trypanosome infections in ruminants, camels, horses and dogs via intramuscular or subcutaneous injection. Horses have a limited tolerance to ISMC (Toro et al., 1983), although it remains an alternative to DA.  
Note: Homidium and ethidium also belong to the phenanthridine family; they have been used in the past, especially in East Africa, however, they are highly toxic because they are DNA intercalating agents; their mutagenic action was demonstrated early (McCann et al., 1975). Therefore, their use in the field is not recommended.
- Quinapyramine (QP) belongs to the group of aminoquinaldine derivatives. Quinapyramine methyl-sulfate can be used to cure infection by subcutaneous injection at a dose of 5 mg/kg bw. A more effective combination of quinapyramine sulfate and quinapyramine chloride (Triquin) can be used as a curative/preventive drug against *T. evansi* in horses and camels (4 months protection).
- Melarsomine hydrochloride (MH) is used to control Surra in camels via deep intramuscular injection at a dose rate of 0.25 mg/kg bw. Evaluations conducted on other host species suggest using rates of 0.25–0.5 mg/kg bw in horses, 0.5 mg/kg bw in cattle, and 0.75 mg/kg bw in buffaloes (Lun et al., 1991; Payne et al., 1994; Desquesnes et al., 2011). Dogs have a satisfactory tolerance to the drug, up to 1–2 mg/kg bw.

#### Parameter 2 – Availability/production capacity (per year)

None of these drugs are available on the French market; however, some of these products are produced in France (DA, ISMC and MH), and the production capacities are high for exportation mostly to Africa. Other countries such as India, China and Brazil are also producing some of these drugs (DA, ISMC and QP). In total, 40 million of doses of trypanocides are sold every year only in Africa (Akoda and Peter, 2015). Some of the drugs available at markets, in particular in Africa, are however very often of poor quality, counterfeit or fake (Tchamdja et al., 2016) and it is wise to ascertain the origin of trypanocidal drugs to be used successfully (Sutcliffe et al., 2014).

#### Effectiveness

#### Parameter 3 – Therapeutic effects on the field (effectiveness)

- DA: If the objective of a treatment is to cure the animal and get rid of the infection, high doses such as 7–10 mg/kg bw should be used; however, success cannot be ascertained and toxicity may limit such practice. Although recommended at the dose of 7 mg/kg bw for *Trypanozoon* infections, the reality in the field often reveals that a dose of 3.5 mg/kg bw is used to control Surra. This could be for various reasons, including ignorance of the right dose, fear for side effects or to induce a shock using high dose, or concern to save money by reducing the cost of treatment. On the other hand, DA has been used for a very long time. Consequently, trypanosomes have developed chemoresistance in most parts of the world (Peregrine and Mamman, 1993). Using 3.5 mg/kg bw to control *T. evansi* can be considered as

underdose, as is often the case, and thus it can help to cure clinical affection, but most of the time the animals will remain carriers of the parasites (Desquesnes et al., 2013a). Finally, in dog treatment, in order to avoid toxic effects but to increase the drug efficacy, serial treatments using 3.5 mg/kg have been attempted (Howes et al., 2011).

- ISMC: If the objective is to cure the animal and get rid of the infection, high doses such as 1–2 mg/kg bw should be used; however, success cannot be ascertained and toxicity may limit such practice. In addition, as a slow eliminated drug, ISMC may easily induce resistance, so it is not a drug of choice for the control of Surra. The withdrawal period for the consumption for cattle injected with IMC is 23 days; which makes IMC poorly adaptable to beef or dairy cattle. Alternate use of DA and ISMC constitutes a 'sanative pair', which means that once resistance develops to one of the drugs, the other drug should be used to control the infection (Dia and Desquesnes, 2004).
- QP is very efficient in horses and can both cure and prevent infection for several months (Dia and Desquesnes, 2004; Desquesnes et al., 2013a). In cattle, the use of QP is not recommended because it may induce cross-resistance to both DA and IMC (Peregrine et al., 1995). Its use should be restricted to horses and camels only at a dose of 5 mg/kg bw.
- MH is used to control Surra in camels, however, some resistance is already suspected. A dose of 0.5 mg/kg bw can be used in camels and horses, while higher doses may be required for successful treatment in bovines.

To date, treatments for bovines in the field are for clinical improvement; it is rare that farmers and veterinarians attempt to get rid of the infection in these hosts.

Conversely, in horses and camels, cure and prevention are necessary and may be obtained using high doses of MH and QP, but only in the blood stage of the infection, since none of these drugs can reach and kill the parasite once the nervous system is invaded.

#### *Feasibility*

##### Parameter 4 – Way of administration

DA and ISMC should be administered via deep intramuscular injection to obtain a high concentration of the chemical in the circulating blood, and to avoid irritant and local reactions.

QP and MH can be administered intramuscularly or by subcutaneous route.

#### **3.1.4.4. Article 7(d)(iv) Biosecurity measures**

##### *Availability*

##### Parameter 1 – Available biosecurity measures

There are no current rules since the disease is not present in the EU, so these are suggestions based on the current knowledge of the disease and past experiences.

External biosecurity measures should focus on controlling the introduction of certainly non-infected livestock (see diagnosis method under point 3 below), and internal biosecurity measures should focus on separating infected from uninfected animals, administration of curative trypanocidal drugs or slaughtering of infected animals, close follow-up of exposed animals and controlling biting flies using protections (mosquito nets) and insecticide treatments (spray).

Care should be taken while slaughtering infected animals and to keep all issues from dead or slaughtered animals for a minimum of 3 days. Destruction of the carcasses and all issues is recommended.

Example of monitoring of a case or an outbreak:

The following measures were successfully applied more than a century ago in a historical case of introduction of Surra infected cattle from India to the USA (Mohler and Thompson, 1909):

- 1) Isolation of infected and exposed animals under individual fly-proof stables;
- 2) Detection of infection amongst the exposed animals by all diagnostic methods available [parasitological, molecular and serological methods should be used nowadays] including rabbit (as was done in the USA) or mouse inoculation technique, three times at 1 month interval;
- 3) Killing of infected animals;
- 4) Follow-up of remaining animals for detection of infection using parasitological, molecular and serological techniques for another 9 months.

## Effectiveness

### Parameter 2 – Effectiveness of biosecurity measures in preventing the pathogen introduction

Preventing pathogen introduction into the EU predominantly means preventing the introduction of infected animals, especially herbivores (because the infection is most often fatal to the carnivores and they are a poor source of infection, mostly considered as an epidemiological cul-de-sac).

For camelids that are introduced to the EU and originating from non-authorised countries, a quarantine must be made in Saint Pierre et Miquelon, and certificates must be provided (RUM and CAM); however, the laboratory tests are of poor efficiency since only negative blood smear examination 2 and more than 42 days after their arrival is requested (Annex I to Regulation (EC) No 206/2010); this diagnosis method being of a very low sensitivity, the risk of undetected carrier is significant. Moreover, these measures should be extended to any infected part of a country such as the Canary Islands, where it is endemic and has been source of infection for the mainland of Spain and France.

Alternatively, the infection might be introduced into the EU via uncontrolled or wild animals, through geographical continuity, especially from Turkey through Greece or Bulgaria. Animal movements between these countries might not be fully under control.

## Feasibility

### Parameter 3 – Feasibility of biosecurity measures

A series of measures to prevent and control Surra in the EU have been proposed to the OIE (not yet approved), as indicated hereafter.

Recommendations for the trading of equines and camelids:

Two quarantines should be applied for international trading of equines and camelids from a country infected to a non-infected country: a quarantine of 4 weeks in the exporting farm and a quarantine of 4 weeks in the importing farm.

To be allowed for trading an animal should originate from a non-infected farm in a non-suspect area, and be negative to Surra tests twice at 3–4 weeks interval during each of the quarantines.

A farm is in a non-suspect area if, in the surrounding of 30 km from its limits, there has been no report of Surra in the last 3 years.

A non-infected farm is a farm located in a non-suspect area, which allows only the introduction of animals negative to Surra tests (according to OIE), originating from a non-infected farm in a non-suspect area. To get the status of a non-infected farm, all mammal animal species must be proved negative to Surra tests twice at 3 months interval. To keep this status, all domestic mammal animal species should prove to be negative to Surra tests after every 10–12 months.

Isolation measures:

Feasibility of isolation, detection and killing was satisfying in the USA experience in 1906 (Mohler and Thompson, 1909).

### **3.1.4.5. Article 7(d)(v) Restrictions on the movement of animals and products**

## Availability

### Parameter 1 – Available movement restriction measures

There are no current restrictions since the disease does not exist in the EU at the present time, but as was done in the case of the two outbreaks observed in Spain and France, animal movements were forbidden as soon as a case or outbreak was identified. Since Surra is a multispecies disease, restriction of all mammal animal movements should be applied until the farm can be declared as non-infected by Surra.

For horses that fall in the category of HHP (sport, breeding, exhibition), OIE is currently establishing particular regulations that are less strict in terms of quarantine depending on the low-risk environment in which these horses are kept.

## Effectiveness

### Parameter 2 – Effectiveness of restriction of animal movement in preventing the between farm spread

There are no current rules since the disease is not present in the EU; however, the restrictions applied in the cases of these outbreaks concerned animals and products (milk, blood, meat and any

carcass issues); these restrictions have been efficient since the disease did not spread outside the infected farms.

#### *Feasibility*

##### Parameter 3 – Feasibility of restriction of animal movement

Because Surra is a multispecies disease and because diagnosis at the individual level is inaccurate due to latent infection, restriction of animal movement should be applied at the farm level to all mammals. Restriction of animal movement is feasible; however, rules should be elaborated and prescribed, even in the absence of the disease, so that they may be applicable as soon as the disease is identified in the EU.

Restriction of movements of wildlife would also be ideal although uncertain; in this case, deer, rabbits, hare, wild pigs and rodents, foxes, wolves, feral dogs and cats might be concerned; feasibility of their movement restriction is uncertain (information based on the French experience and expert opinion).

#### **3.1.4.6. Article 7(d)(vi) Killing of animals**

##### *Availability*

##### Parameter 1 – Available methods for killing animals

Animal killing measures are not applied in the EU due to Surra since the disease is not present.

##### *Effectiveness*

##### Parameter 2 – Effectiveness of killing animals (at farm level or within the farm) for reducing/stopping spread of the disease

Unless all animals have been individually isolated under fly-proof conditions, effectiveness of killing infected animals within the farm may be low due to latent infections and potential false negative results to all diagnostic methods, thus, long-term follow-up is requested (12 months) to ensure complete effectiveness.

Farm level killing is safer but might not be justified, depending on the conditions of the outbreak. If successfully applied, the measure would be fully efficient.

Killing of animals was effective in two historical examples: (1) in Australia, where Surra was found once in imported camels at Port Hedland in 1907 (Hoare, 1972), and (2) in the USA, where Surra was introduced into three cattle imported from India in 1906; in the latter case, the strict isolation of the animals in fly-proof conditions, diagnosis through rabbit inoculation and killing of infected animals led to successful eradication (Mohler and Thompson, 1909).

##### *Feasibility*

##### Parameter 3 – Feasibility of killing animals

Killing of ruminants might be accepted by farmers, due to other pre-existing rules for other diseases in these stocks; however, for horses and camels, farmers are more reluctant to slaughter, which may lead to a low immediate feasibility. This was observed in the outbreak in camels in the Aveyron, France (Desquesnes et al., 2008), where, despite the Ministerial decision for the culling of infected/positive animals, the measures were not applied due to legal claims by the camel's owner.

#### **3.1.4.7. Article 7(d)(vii) Disposal of carcasses and other relevant animal by-products**

##### *Availability*

##### Parameter 1 – Available disposal option

Because Surra is sporadic in the EU, a limited number of animals would be concerned, so destruction of the carcasses and all associated material is recommended. However, if high value or high numbers of animals are concerned, economic parameters might lead to meat from animals slaughtered due to Surra infection being used; based on expert knowledge, care must be taken as concerns slaughtering since the blood and other issues are contagious; after 1 week maturation at 4°C or below, meat would be safe for animal and human consumption. Milk products should be heat treated to inactivate the parasite.



## Effectiveness

### Parameter 2 – Effectiveness of disposal option

Survival of *T. evansi* in blood and meat is estimated to 2 days, thus, 1 week maturation at 4°C would be safe for animal and human consumption; however, care must be taken as concerns slaughtering conditions since the blood and other issues are contaminative. Survival of *T. evansi* in milk has not been determined but could also range around 2 days, thus, milk should not be used raw because peroral infection through milk is possible (Campigotto et al., 2015). Milk products should be heat treated to kill the parasites.

## Feasibility

### Parameter 3 – Feasibility of disposal option

Specifically equipped slaughterhouses and well-trained technicians might operate the culling for appropriate disposal options. All other issues should be destroyed to avoid human exposure and spreading through wild rats and roaming dogs and cats.

A risk might remain for carnivores such as dogs and cats to get contaminated in the farm through eating raw milk (Campigotto et al., 2015), placenta or carcass of infected animals.

## 3.1.5. Article 7(e) The impact of disease prevention and control measures

### 3.1.5.1. Article 7(e)(i) The direct and indirect costs for the affected sectors and the economy as a whole

#### Parameter 1 – Cost of control (e.g. treatment/vaccine, biosecurity)

There has been no official assessment of this aspect.

#### Parameter 2 – Cost of eradication (culling, compensation)

Cost of culling in ruminants would not be different from other diseases and might concern either positive animals through a 1 year follow-up or all animals on the farm.

#### Parameter 3 – Cost of surveillance and monitoring

Although studies assessing the costs for surveillance for Surra are not available, the following could be supposed:

- If the current four diagnosis methods recommended by the OIE are applied, cost of surveillance and monitoring can be estimated at around 80–100 €/sample. Since animals should be checked with the 4 tests every month for 12 months, a laboratory cost of around 1,200 €/head can be predicted;
- A TL can be performed to confirm CATT and ELISA, however the TL is time consuming and the cost, around 250 €/sample, would increase the total cost of such follow-up by  $\times 3.5$  (OIE, 2012).

#### Parameter 4 - Trade loss (bans, embargoes, sanctions) by animal product

These might be significant in camels and horse farm activities, as well as in milk and/or meat producing farms for animal product trading, but this has not been assessed formally.

#### Parameter 5 - Importance of the disease for the affected sector (% loss or € lost compared to business amount of the sector)

There has been no assessment of this aspect.

### 3.1.5.2. Article 7(e)(ii) The societal acceptance of disease prevention and control measures

So far, there have been two recent outbreaks of Surra in Europe: in France and Spain.

Killing of horses and camels generally can be considered with low societal acceptance.

### 3.1.5.3. Article 7(e)(iii) The welfare of affected subpopulations of kept and wild animals

#### Parameter 1 – Welfare impact of control measures on domestic animals

Animal welfare can be affected if offspring is isolated from their dam at birth, which is recommended due to a possible passage of the parasite through milk and colostrum (Campigotto et al., 2015).



### Parameter 2 – Wildlife depopulation as control measure

No impact on the environment and biodiversity has been identified, and wild rodents have not been identified as an active source of infection so far (Rodríguez et al., 2010).

#### 3.1.5.4. Article 7(e)(iv) The environment and biodiversity

##### Environment

#### Parameter 1 – Use and potential residuals of biocides or medical drugs in environmental compartments (soil, water, feed, manure)

When vector control is attempted using insecticide sprays, insecticide residues can be spread in the environment, and then contaminate soil, water, feed and manure. However, such contamination would not be greater than those generated by any other insecticide/acaricide treatment which could be applied for the control of ticks or biting flies.

There are no data on the potential residuals of trypanocidal drugs in environmental compartments.

##### Biodiversity

#### Parameter 2 – Mortality in wild species

No impact on the environment and biodiversity has been identified, but if wildlife is implicated in transmission (deer, wild pigs, etc.), and regulation of wildlife is deemed needed, a systematic assessment of the biodiversity would be required.

In Latin America, capybara control might be of concern.

### 3.2. Assessment according to Article 5 criteria

This section presents, the results of the expert judgement on the criteria of Article 5 of the AHL about *T. evansi* infections (including Surra) (Table 1). The expert judgement was based on Individual and Collective Behavioural Aggregation (ICBA) approach described in detail in the opinion on the methodology (EFSA AHAW Panel, 2017). Experts have been provided with information of the disease fact-sheet mapped into Article 5 criteria (see supporting information, Annex A), based on that the experts indicate their Y/N or 'na' judgement on each criterion of Article 5, and the reasoning supporting their judgement.

The minimum number of judges in the judgement was nine. The expert judgement was conducted as described in the methodological opinion (EFSA AHAW Panel, 2017). For details on the interpretation of the questions, see Appendix B of the methodological opinion (EFSA AHAW Panel, 2017).

**Table 1:** Outcome of the expert judgement on the Article 5 criteria for *Trypanosoma evansi* infections (including Surra)

<b>Criteria to be met by the disease:</b> According to AHL, a disease shall be included in the list referred to in point (b) of paragraph 1 of Article 5 if it has been assessed in accordance with Article 7 and meets all of the following criteria		<b>Final outcome</b>
A(i)	The disease is transmissible	Y
A(ii)	Animal species are either susceptible to the disease or vectors and reservoirs thereof exist in the Union	Y
A(iii)	The disease causes negative effects on animal health or poses a risk to public health due to its zoonotic character	Y
A(iv)	Diagnostic tools are available for the disease	Y
A(v)	Risk-mitigating measures and, where relevant, surveillance of the disease are effective and proportionate to the risks posed by the disease in the Union	NC
<b>At least one criterion to be met by the disease:</b> In addition to the criteria set out above at points A(i)–A(v), the disease needs to fulfil at least one of the following criteria		
B(i)	The disease causes or could cause significant negative effects in the Union on animal health, or poses or could pose a significant risk to public health due to its zoonotic character	Y

B(ii)	The disease agent has developed resistance to treatments and poses a significant danger to public and/or animal health in the Union	Y
B(iii)	The disease causes or could cause a significant negative economic impact affecting agriculture or aquaculture production in the Union	Y
B(iv)	The disease has the potential to generate a crisis or the disease agent could be used for the purpose of bioterrorism	NC
B(v)	The disease has or could have a significant negative impact on the environment, including biodiversity, of the Union	NC

Colour code: green = consensus (Yes/No); yellow = no consensus (NC).

### 3.2.1. Non-consensus questions

This section displays, the assessment related to each criterion of Article 5 where no consensus was achieved in form of tables (Tables 2, 3 and 4). The proportion of Y, N or na answers are reported, followed by the list of different supporting views for each answer.

**Table 2:** Outcome of the expert judgement related to criterion 5 A(v)

Question		Final outcome	Response		
			Y (%)	N (%)	na (%)
A(v)	Risk-mitigating measures and, where relevant, surveillance of the disease are effective and proportionate to the risks posed by the disease in the Union	NC	78	22	0

NC: non-consensus; number of judges: 9.

#### Reasoning supporting the judgement

##### Supporting Yes:

- The measures taken to prevent introduction to EU appear to be effective, as evidenced by occurrence of only very few sporadic outbreaks in the EU.

##### Supporting No:

- If the disease is introduced and spread, risk-mitigating measures may not be sufficient. Even though diagnostic tools are in place, they are not accurate for detection of latent infections. Furthermore, vaccines are not available and chemotherapeutic treatment is not authorised in the EU.
- EU regulations and movement restriction are in place, except in some cases for Equidae (the importation of potentially exposed/infected Equidae into Europe may occur) and camelids (Canary Islands, Spain), which may pose a risk of introduction. There are similar concerns with respect to the movement of animals from Turkey to Greece or Bulgaria.

**Table 3:** Outcome of the expert judgement related to criterion 5 B(iv)

Question		Final outcome	Response		
			Y (%)	N (%)	na (%)
B(iv)	The disease has the potential to generate a crisis or the disease agent could be used for the purpose of bioterrorism	NC	44	56	0

NC: non-consensus; number of judges: 9.

#### Reasoning supporting the judgement

##### Supporting Yes:

- The disease could generate concern in the high-value horse and camel industries.

##### Supporting No:

- The disease is not listed as a bioterrorism agent.

**Table 4:** Outcome of the expert judgement related to criterion 5 B(v)

Question		Final outcome	Response		
			Y (%)	N (%)	na (%)
B(v)	The disease has or could have a significant negative impact on the environment, including biodiversity, of the Union	NC	22	78	0

NC: non-consensus; Number of judges: 9.

#### Reasoning supporting the judgement

##### Supporting Yes:

- The host range is very wide, and it is possible that endangered European species could be affected.
- The disease can affect deer and carnivores, with potential high mortality, although data are not available.

##### Supporting No:

- The population decrease in wildlife caused by the disease is unlikely to be significant.

### 3.2.2. Outcome of the assessment of *Trypanosoma evansi* infections (including Surra) according to criteria of Article 5(3) of the AHL on its eligibility to be listed

As from the legal text of the AHL, a disease is considered eligible to be listed as laid down in Article 5 if it fulfils all criteria of the first set from A(i) to A(v) and at least one of the second set of criteria from B(i) to B(v). According to the assessment methodology (EFSA AHAW Panel, 2017), a criterion is considered fulfilled when the outcome is 'Yes'. According to the results shown in Table 1, *T. evansi* infections complies with criteria from A(i) to A(iv) of the first set and the assessment is inconclusive on compliance with criterion A(v). Therefore, it is inconclusive whether *T. evansi* infections can be considered eligible to be listed for Union intervention as laid down in Article 5(3) of the AHL.

### 3.3. Assessment according to Article 9 criteria

This section presents the results of the expert judgement on the criteria of Annex IV referring to categories as in Article 9 of the AHL about *T. evansi* infections (including Surra) (Tables 5, 6, 7, 8 and 9). The expert judgement was based on ICBA approach described in detail in the opinion on the methodology. Experts have been provided with information of the disease fact-sheet mapped into Article 9 criteria (see supporting information, Annex A), based on that the experts indicate their Y/N or 'na' judgement on each criterion of Article 9, and the reasoning supporting their judgement. The minimum number of judges in the judgement was nine. The expert judgement was conducted as described in the methodological opinion (EFSA AHAW Panel, 2017). For details on the interpretation of the questions see Appendix B of the methodological opinion (EFSA AHAW Panel, 2017).

**Table 5:** Outcome of the expert judgement related to the criteria of Section 1 of Annex IV (category A of Article 9) for *Trypanosoma evansi* infections (Surra)

Criteria to be met by the disease: The disease needs to fulfil all of the following criteria		Final outcome
1	The disease is not present in the territory of the Union OR present only in exceptional cases (irregular introductions) OR present in only in a very limited part of the territory of the Union	Y
2.1	The disease is highly transmissible	N
2.2	There be possibilities of airborne or waterborne or vector-borne spread	Y
2.3	The disease affects multiple species of kept and wild animals OR single species of kept animals of economic importance	Y
2.4	The disease may result in high morbidity and significant mortality rates	Y

**At least one criterion to be met by the disease:**

In addition to the criteria set out above at points 1–2.4, the disease needs to fulfil at least one of the following criteria

3	The disease has a zoonotic potential with significant consequences on public health, including epidemic or pandemic potential OR possible significant threats to food safety	N
4	The disease has a significant impact on the economy of the Union, causing substantial costs, mainly related to its direct impact on the health and productivity of animals	NC
5(a)	The disease has a significant impact on society, with in particular an impact on labour markets	NC
5(b)	The disease has a significant impact on animal welfare, by causing suffering of large numbers of animals	Y
5(c)	The disease has a significant impact on the environment, due to the direct impact of the disease OR due to the measures taken to control it	N
5(d)	The disease has a significant impact on a long-term effect on biodiversity or the protection of endangered species or breeds, including the possible disappearance or long-term damage to those species or breeds	NC

Colour code: green = consensus (Yes/No); yellow = no consensus (NC).

**Table 6:** Outcome of the expert judgement related to the criteria of Section 2 of Annex IV (category B of Article 9) for *Trypanosoma evansi* infections (Surra)

<b>Criteria to be met by the disease:</b> The disease needs to fulfil all of the following criteria		<b>Final outcome</b>
1	The disease is present in the whole OR part of the Union territory with an endemic character AND (at the same time) several Member States or zones of the Union are free of the disease	N
2.1	The disease is moderately to highly transmissible	Y
2.2	There be possibilities of airborne or waterborne or vector-borne spread	Y
2.3	The disease affects single or multiple species	Y
2.4	The disease may result in high morbidity with in general low mortality	N

**At least one criterion to be met by the disease:**

In addition to the criteria set out above at points 1–2.4, the disease needs to fulfil at least one of the following criteria

3	The disease has a zoonotic potential with significant consequences on public health, including epidemic potential OR possible significant threats to food safety	N
4	The disease has a significant impact on the economy of the Union, causing substantial costs, mainly related to its direct impact on the health and productivity of animals	NC
5(a)	The disease has a significant impact on society, with in particular an impact on labour markets	NC
5(b)	The disease has a significant impact on animal welfare, by causing suffering of large numbers of animals	Y
5(c)	The disease has a significant impact on the environment, due to the direct impact of the disease OR due to the measures taken to control it	N
5(d)	The disease has a significant impact on a long-term effect on biodiversity or the protection of endangered species or breeds, including the possible disappearance or long-term damage to those species or breeds	NC

Colour code: green = consensus (Yes/No); yellow = no consensus (NC).

**Table 7:** Outcome of the expert judgement related to the criteria of Section 3 of Annex IV (category C of Article 9) for *Trypanosoma evansi* infections (Surra)

<b>Criteria to be met by the disease:</b> The disease needs to fulfil all of the following criteria		<b>Final outcome</b>
1	The disease is present in the whole OR part of the Union territory with an endemic character	N
2.1	The disease is moderately to highly transmissible	Y
2.2	The disease is transmitted mainly by direct or indirect transmission	Y
2.3	The disease affects single or multiple species	Y

2.4	The disease usually does not result in high morbidity and has negligible or no mortality AND often the most observed effect of the disease is production loss	N
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**At least one criterion to be met by the disease:**

In addition to the criteria set out above at points 1–2.4, the disease needs to fulfil at least one of the following criteria

3	The disease has a zoonotic potential with significant consequences on public health, or possible significant threats to food safety	N
4	The disease has a significant impact on the economy of parts of the Union, mainly related to its direct impact on certain types of animal production systems	N
5(a)	The disease has a significant impact on society, with in particular an impact on labour markets	NC
5(b)	The disease has a significant impact on animal welfare, by causing suffering of large numbers of animals	Y
5(c)	The disease has a significant impact on the environment, due to the direct impact of the disease OR due to the measures taken to control it	N
5(d)	The disease has a significant impact on a long-term effect on biodiversity or the protection of endangered species or breeds, including the possible disappearance or long-term damage to those species or breeds	NC

Colour code: green = consensus (Yes/No); yellow = no consensus (NC).

**Table 8:** Outcome of the expert judgement related to the criteria of Section 4 of Annex IV (category D of Article 9) for *Trypanosoma evansi* infections (Surra)

<b>Criteria to be met by the disease:</b> The disease needs to fulfil all of the following criteria		<b>Final outcome</b>
D	The risk posed by the disease in question can be effectively and proportionately mitigated by measures concerning movements of animals and products in order to prevent or limit its occurrence and spread	Y
Criteria of Sections 1, 2, 3 or 5 of Annex IV of AHL		NC

Colour code: green = consensus (Yes/No); yellow = no consensus (NC).

**Table 9:** Outcome of the expert judgement related to the criteria of Section 5 of Annex IV (category E of Article 9) for *Trypanosoma evansi* infections (Surra)

<b>Diseases in category E need to fulfil criteria of Sections 1, 2 or 3 of Annex IV of AHL and/or the following:</b>		<b>Final outcome</b>
E	Surveillance of the disease is necessary for reasons relating to animal health, animal welfare, human health, the economy, society or the environment (If a disease fulfils the criteria as in Article 5, thus being eligible to be listed, consequently category E would apply.)	NC

Colour code: yellow = no consensus (NC).

### 3.3.1. Non-consensus questions

This section displays, the assessment related to each criterion of Annex IV referring to the categories of Article 9 of the AHL where no consensus was achieved in form of tables (Tables 10, 11 and 12). The proportion of Y, N or 'na' answers are reported, followed by the list of different supporting views for each answer.

**Table 10:** Outcome of the expert judgement related to criterion 4 of Article 9

<b>Question</b>	<b>Final outcome</b>	<b>Response</b>		
		<b>Y (%)</b>	<b>N (%)</b>	<b>na (%)</b>
4 (cat.A,B) The disease has a significant impact on the economy of the Union, causing substantial costs, mainly related to its direct impact on the health and productivity of animals	NC	89	11	0

NC: non-consensus; number of judges: 9.

Reasoning supporting the judgement

## Supporting Yes:

- Multiple animal species can be affected.
- If Surra is introduced into the EU, the impact may be significant (high mortality and morbidity described in horses and dogs).

## Supporting No:

- There is currently no disease and therefore no impact within the EU, but if the disease was introduced into the EU and no control was in place, the impact would be significant.

**Table 11:** Outcome of the expert judgement related to criterion 5(a) of Article 9

Question	Final outcome	Response		
		Y (%)	N (%)	na (%)
5(a) The disease has a significant impact on society, with in particular an impact on labour markets	NC	33	67	0

NC: non-consensus; number of judges: 9.

Reasoning supporting the judgement

## Supporting Yes:

- In endemic countries, although Surra has a very low prevalence (in very limited part of the EU it can be endemic/epidemic, e.g. in Canary Islands), high mortality and morbidity has been described in horses and dogs.
- The impact on society may be significant because of the type of animals affected (companion animals and valuable horses and camelids).

## Supporting No:

- Currently, there is no impact on society or labour markets, since the disease is absent. If the disease was introduced into the EU and no control was in place, the impact would be significant.

**Table 12:** Outcome of the expert judgement related to criterion 5(d) of Article 9

Question	Final outcome	Response		
		Y (%)	N (%)	na (%)
5(d) The disease has a significant impact on a long-term effect on biodiversity or the protection of endangered species or breeds, including the possible disappearance or long-term damage to those species or breeds	NC	11	89	0

NC: non-consensus; number of judges: 9.

Reasoning supporting the judgement

## Supporting Yes:

- Potential mortality in wild animals species at EU level including endangered species such as carnivores (e.g. bear, lynx).

## Supporting No:

- It may have potential mortality in wild animals species at EU level, but in general low prevalence is recorded apart from endemic areas.



### 3.3.2. Outcome of the assessment of criteria in Annex IV for *Trypanosoma evansi* infections (including Surra) for the purpose of categorisation as in Article 9 of the AHL

As from the legal text of the AHL, a disease is considered fitting in a certain category (A, B, C, D or E corresponding to point (a) to point (e) of Article 9(1) of the AHL) if it is eligible to be listed for Union intervention as laid down in Article 5(3) and fulfils all criteria of the first set from 1 to 2.4 and at least one of the second set of criteria from 3 to 5(d) as shown in Tables 3–7. According to the assessment methodology (EFSA AHAW Panel, 2017), a criterion is considered fulfilled when the outcome is 'Yes'.

A description of the outcome of the assessment of criteria in Annex IV for *Trypanosoma evansi* infections (including Surra) for the purpose of categorisation as in Article 9 of the AHL is presented in Table 13.

**Table 13:** Outcome of the assessment of criteria in Annex IV for *Trypanosoma evansi* infections (including Surra) for the purpose of categorisation as in Article 9 of the AHL

Category	Article 9 criteria										
	1° set of criteria					2° set of criteria					
	1	2.1	2.2	2.3	2.4	3	4	5a	5b	5c	5d
	Geographical distribution	Transmissibility	Routes of transmission	Multiple species	Morbidity and mortality	Zoonotic potential	Impact on economy	Impact on society	Impact on animal welfare	Impact on environment	Impact on biodiversity
A	Y	N	Y	Y	Y	N	NC	NC	Y	N	NC
B	N	Y	Y	Y	N	N	NC	NC	Y	N	NC
C	N	Y	Y	Y	N	N	N	NC	Y	N	NC
D	NC										
E	NC										

According to the assessment here performed, *Trypanosoma evansi* infections (including Surra) comply with the following criteria of the sections 1–5 of Annex IV of the AHL for the application of the disease prevention and control rules referred to in points (a) to (e) of Article 9(1):

- 1) To be assigned to category A, a disease needs to comply with all criteria of the first set (1, 2.1–2.4) and according to the assessment *T. evansi* infections comply with criteria 1, 2.2, 2.3 and 2.4 but not with 2.1. To be eligible for category A, a disease needs to comply additionally with one of the criteria of the second set (3, 4, 5a–d) and *T. evansi* infections comply with criterion 5b, do not comply with criteria 3 and 5c and the assessment is inconclusive on compliance with criteria 4, 5a and 5d.
- 2) To be assigned to category B, a disease needs to comply with all criteria of the first set (1, 2.1–2.4) and according to the assessment *T. evansi* infections comply with criteria 2.1, 2.2 and 2.3 but not with 1 and 2.4. To be eligible for category B, a disease needs to comply additionally with one of the criteria of the second set (3, 4, 5a–d) and *T. evansi* infections comply with criterion 5b, do not comply with criteria 3 and 5c and the assessment is inconclusive on compliance with criteria 4, 5a and 5d.
- 3) To be assigned to category C, a disease needs to comply with all criteria of the first set (1, 2.1–2.4) and according to the assessment *T. evansi* infections comply with criteria 2.1, 2.2 and 2.3 but not with 1 and 2.4. To be eligible for category C, a disease needs to comply additionally with one of the criteria of the second set (3, 4, 5a–d) and *T. evansi* infections comply with criterion 5b, do not comply with criteria 3, 4 and 5c and the assessment is inconclusive on compliance with criteria 5a and 5d.

- 4) To be assigned to category D, a disease needs to comply with criteria of section 1, 2, 3 or 5 of Annex IV of the AHL, whose assessment performed is inconclusive for *T. evansi* infections, and with the specific criterion D of section 4, which *T. evansi* infections comply with.
- 5) To be assigned to category E, a disease needs to comply with criteria of section 1, 2 or 3 of Annex IV of the AHL and/or the surveillance of the disease is necessary for reasons relating to animal health, animal welfare, human health, the economy, society or the environment. The latter is applicable if a disease fulfils the criteria as in Article 5 and the assessment here performed for *T. evansi* infections is inconclusive on compliance with the criteria as in Article 5.

### 3.4. Assessment of Article 8

This section presents, the results of the assessment on the criteria of Article 8(3) of the AHL about *T. evansi* infections (including Surra). The Article 8(3) criteria are about animal species to be listed, as it reads below:

'3. Animal species or groups of animal species shall be added to this list if they are affected or if they pose a risk for the spread of a specific listed disease because:

- a) they are susceptible for a specific listed disease or scientific evidence indicates that such susceptibility is likely; or
- b) they are vector species or reservoirs for that disease, or scientific evidence indicates that such role is likely'.

For this reason, the assessment on Article 8 criteria is based on the evidence as extrapolated from the relevant criteria of Article 7, i.e. the ones related to susceptible and reservoir species or routes of transmission, which cover also possible role of biological or mechanical vectors.<sup>3</sup> According to the mapping, as presented in Table 5, section 3.2 of the scientific opinion on the ad hoc methodology (EFSA AHAW Panel, 2017), the main animal species to be listed for *T. evansi* infections (including Surra) according to the criteria of Article 8(3) of the AHL are as displayed in Table 14.

**Table 14:** Animal species to be listed for *Trypanosoma evansi* infections (including Surra) according to criteria of Article 8 (source: data reported in Section 3.1.1.1 and 3.1.1.6)

	Class	Order	Family	Genus/species
Susceptible	Mammalia	Almost all	Almost all	Almost all
Reservoir	Mammalia	Artiodactyla	Bovidae	Almost all
			Cervidae	Not specified
			Suidae	<i>Sus scrofa</i>
			Camelidae	Not specified
		Perissodactyla	Equidae	<i>Equus</i> spp.
		Rodentia	Caviidae	<i>Hydrochoerus hydrochaeris</i>
		Chiroptera	Phyllostomidae	<i>Desmodus rotundus</i> , <i>Diphylla ecaudata</i> , <i>Diaemus youngi</i>
Vectors	Insecta	Diptera	Tabanidae	<i>Tabanus</i> spp., <i>Chrysops</i> spp., <i>Haematopota</i> spp.

## 4. Conclusions

**TOR 1:** for each of those diseases an assessment, following the criteria laid down in Article 7 of the AHL, on its eligibility of being listed for Union intervention as laid down in Article 5(3) of the AHL;

- According to the assessment here performed, it is inconclusive whether *T. evansi* infections (including Surra) can be considered eligible to be listed for Union intervention as laid down in Article 5(3) of the AHL. Eligibility of listing *T. evansi* infections (including Surra) is dependent on a decision on criterion 5 A(v).

<sup>3</sup> A vector is a living organism that transmits an infectious agent from an infected animal to a human or another animal. Vectors are frequently arthropods. Biological vectors may carry pathogens that can multiply within their bodies and be delivered to new hosts, usually by biting. In mechanical vectors the pathogens do not multiply within the vector, which usually remains infected for shorter time than in biological vectors.

**TOR 2a:** for each of the diseases which was found eligible to be listed for Union intervention, an assessment of its compliance with each of the criteria in Annex IV to the AHL for the purpose of categorisation of diseases in accordance with Article 9 of the AHL;

- According to the assessment here performed, since it is inconclusive whether *T. evansi* infections (including Surra) can be considered eligible to be listed for Union intervention as laid down in Article 5(3) of the AHL, then also the assessment of its compliance with the criteria as in Sections 4 and 5 of Annex IV of the AHL, for the application of the disease prevention and control rules referred to in points (d) and (e) of Article 9(1) of the AHL is inconclusive.

**TOR 2b:** for each of the diseases which was found eligible to be listed for Union intervention, a list of animal species that should be considered candidates for listing in accordance with Article 8 of the AHL.

- According to the assessment here performed, since it is inconclusive whether *T. evansi* infections (including Surra) can be considered eligible to be listed for Union intervention as laid down in Article 5(3) of the AHL, then it is also inconclusive which animal species can be considered to be listed for *T. evansi* infections (including Surra) according to Article 8(3) of the AHL.

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## Abbreviations

AHAW	EFSA Panel on Animal Health and Welfare
AHL	Animal Health Law
ApoL1	apolipoprotein-L1
bw	body weight
CATT	card agglutination trypanosomiasis test
CFSPH	Center for Food Security and Public Health
CITES	The Convention on International Trade in Endangered Species of Wild Fauna and Flora
CSF	cerebrospinal fluid
DA	diminazene aceturate
DALY	disability-adjusted life year
ELISA	enzyme-linked immunosorbent assay
FAO	Food and Agriculture Organization of the United Nations
GSBS	Giemsa stained blood smear
HCT	haematocrit centrifuge technique
HHP	high health, high performance
ICBA	Individual and Collective Behavioural Aggregation
IgG	immunoglobulin G
ISMC	isometamidium chloride
IUCN	International Union for Conservation of Nature
mAECT	mini Anion Exchange Centrifugation Test
MH	melarsomine hydrochloride
MIT	mouse inoculation technique
MS	Member State
NPV	negative predictive value
OIE	World Organisation for Animal Health
PCR	polymerase chain reaction
PPV	positive predictive value
QP	quinapyramine
Se	diagnostic sensitivity
Sp	diagnostic specificity
TL	trypanolysis test
ToR	Terms of Reference
VSG	variant surface glycoprotein